

Abstracts

CATALYSIS – INDUSTRIAL PROCESSES

Heterogeneous Catalytic Chemistry by Example of Industrial Applications

J. Heveling, *J. Chem. Educ.*, 2012, **89**, (12), 1530–1536

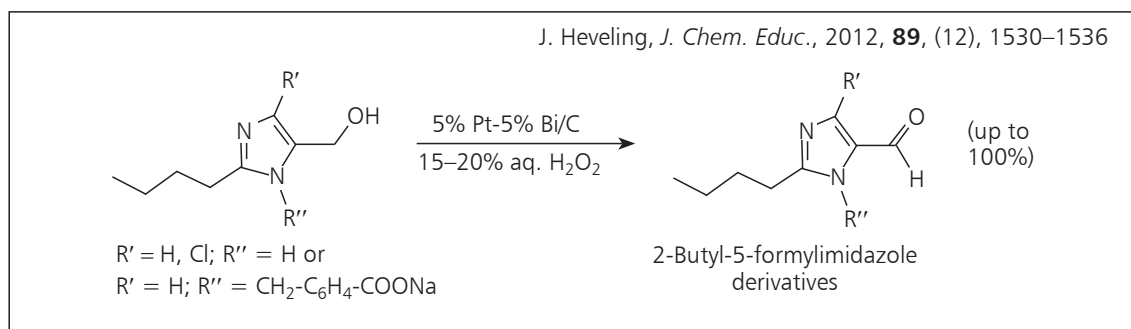
A heterogeneous metal catalyst typically consists of the active metal component, promoters and a support material. The metallic state itself may form the active ingredient. Examples of practical industrial importance are used by the author to highlight important principles of catalysis. These include for the pgms: ammonia oxidation (Pt-Rh), automotive exhaust catalysts (Pt, Pd and Rh) and oxidation catalysts (Pt-Bi).

followed by treatment with an ethanol solution of PdCl₂. The prepared catalyst was air- and moisture-stable. Phenyl halides were coupled with alkenes in DMF under air, to afford the corresponding products in good yields. The catalyst could be easily recovered by filtration and reused for up to 6 cycles.

Hydrogenation of Phenol Using Silica-Supported Pd and PdAu Catalysts in the Presence of H₂ and O₂

S. Okada, K. Fujiwara, T. Kamegawa, K. Mori and H. Yamashita, *Bull. Chem. Soc. Jpn.*, 2012, **85**, (9), 1057–1059

2-Cyclohexen-1-one was obtained from phenol



CATALYSIS – REACTIONS

Photocatalytic Hydrogen Generation in the Presence of Ethanolamines over Pt/ZnIn₂S₄ under Visible Light Irradiation

Y. Li, K. Zhang, S. Peng, G. Lu and S. Li, *J. Mol. Catal. A: Chem.*, 2012, **363–364**, 354–361

The photocatalytic activity for H₂ evolution and decomposition of ethanolamine (EA), diethanolamine (di-EA) and triethanolamine (tri-EA) as electron donors (pollutants) over Pt/ZnIn₂S₄ were investigated. The Pt was deposited on ZnIn₂S₄ by *in situ* photoreduction of H₂PtCl₆. The order of activity for H₂ evolution was: tri-EA >> di-EA > EA. The order of adsorption intensity of the ethanolamines on ZnIn₂S₄ was: EA > di-EA >> tri-EA. The order of activity was found to depend on their molecular structure and adsorption performance.

Application of an Air-and-Moisture-Stable Diphenylphosphinite Cellulose-Supported Nanopalladium Catalyst for a Heck Reaction

Q. Du and Y. Li, *Res. Chem. Intermed.*, 2012, **38**, (8), 1807–1817

The title catalyst (Cell-OPPh₂-Pd⁰) was prepared from cellulose and chlorodiphenylphosphine in pyridine,

by hydrogenation under H₂ and O₂ gases using a Pd/SiO₂ catalyst. The effects of the H₂:O₂ ratio, solvent and alloying Pd with Au were all investigated. Similar transformations to form corresponding cyclic enones were achieved with other phenolic type compounds.

Iridium-Catalyzed Intramolecular [4 + 2] Cycloadditions of Alkynyl Halides

A. Tigchelaar and W. Tam, *Beilstein J. Org. Chem.*, 2012, **8**, 1765–1770

Ir-catalysed intramolecular [4 + 2] cycloadditions of diene-tethered alkynyl halides were carried out using [IrCl(cod)]₂. The most suitable phosphine ligand for the reaction was dppe. The cycloadditions proceeded smoothly at 90°C to give the halogenated cycloadducts in good yield (75–94%). No oxidative insertion of the Ir into the carbon–halide bond was observed.

EMISSIONS CONTROL

A Three-Electrode Column for Pd-Catalytic Oxidation of TCE in Groundwater with Automatic pH-Regulation and Resistance to Reduced Sulfur Compound Foiling

S. Yuan, M. Chen, X. Mao and A. N. Alshwabkeh, *Water Res.*, 2013, **47**, (1), 269–278

A hybrid electrolysis and Pd-catalysed oxidation process was evaluated for the degradation of trichloroethylene (TCE) in groundwater. A three-electrode (one anode and two cathodes) column was used to automatically develop a low pH in the vicinity of Pd and neutral effluent. Simulated groundwater containing up to 5 mM bicarbonate could be acidified to below pH 4 in the vicinity of Pd using a total of 60 mA with 20 mA passing through the third electrode. By packing 2 g of Pd/Al₂O₃ pellets in the developed acidic region, the column efficiency for TCE oxidation in simulated groundwater (5.3 mg l⁻¹ TCE) increased from 44% to 59% and 68% with increasing Fe(II) concentration from 0 mg l⁻¹ to 5 mg l⁻¹ and 10 mg l⁻¹, respectively. This process may be used to control the fouling caused by reduced sulfur compounds (RSCs) because the *in situ* generated reactive oxidising species such as O₂, H₂O₂ and ·OH can oxidise RSCs.

A New Oxygen Storage Capacity Material of a Tin-Doped Ceria–Zirconia-Supported Palladium–Alumina Catalyst with High CO Oxidation Activity

Q. Dong, S. Yin, C. Guo and T. Sato, *Chem. Lett.*, 2012, **41**, (10), 1250–1252

Ce_{0.5}Zr_{0.4}Sn_{0.1}O₂/Pd–Al₂O₃ composite catalysts were prepared by mechanical mixing of Ce_{0.5}Zr_{0.4}Sn_{0.1}O₂ and 2 wt% Pd–Al₂O₃ powder (weight ratio of Ce_{0.5}Zr_{0.4}Sn_{0.1}O₂:Pd–Al₂O₃ = 50:50). These composites had a high BET surface area of 38 m² g⁻¹ and exhibited a high oxygen storage capacity and high CO oxidation activity at low temperatures, even after calcination at 1000°C for 20 h. The authors state that the prepared Ce_{0.5}Zr_{0.4}Sn_{0.1}O₂/Pd–Al₂O₃ has potential as a key material in advanced catalytic converters for the design of three-way catalysts.

Application of a Re–Pd Bimetallic Catalyst for Treatment of Perchlorate in Waste Ion-Exchange Regenerant Brine

J. Liu, J. K. Choe, Z. Sasnow, C. J. Werth and T. J. Strathmann, *Water Res.*, 2013, **47**, (1), 91–101

Re–Pd/C was shown to reduce ClO₄⁻ to Cl⁻ in waste ion-exchange (IX) brines. The catalyst activity was not inhibited in synthetic NaCl-only brine compared to DI water. Re–Pd/C was deactivated by reaction with excess NO₃⁻ present in the real waste IX brine. The deactivation of the Re–Pd/C catalyst could be prevented by pretreating NO₃⁻ with an In–Pd/Al₂O₃ catalyst.

FUEL CELLS

Self-Recovery of Pd Nanoparticles That Were Dispersed over La(Sr)Fe(Mn)O₃ for Intelligent Oxide Anodes of Solid-Oxide Fuel Cells

T. H. Shin, Y. Okamoto, S. Ida and T. Ishihara, *Chem. Eur. J.*, 2012, **18**, (37), 11695–11702

High-performance ‘intelligent oxide anodes’ for SOFCs have been prepared. These anodes can achieve self-recovery from power density degradation during the redox cycle by using a Pd-substituted La(Sr)Fe(Mn)O₃ cell as an oxide anode. The recovery of the power density could be explained by the formation of Pd NPs, which were self-recovered through reoxidation and reduction. This process was shown to be effective for improving the durability of SOFC systems when under severe operating conditions.

A Dual-Chambered Microbial Fuel Cell with Ti/Nano-TiO₂/Pd Nano-Structure Cathode

M. G. Hosseini and I. Ahadzadeh, *J. Power Sources*, 2012, **220**, 292–297

The title cathode was used in a dual-chambered microbial fuel cell with a graphite anode and a Flemion cation exchange membrane. Ti/nano-TiO₂/Pd gave satisfactory long term performance as a cathode to reduce water dissolved oxygen. The maximum output power of the cell was about 200 mW m⁻² normalised to the cathode surface area. The open circuit potential of the cell was about 480 mV and the value of the short circuit current was 0.21 mA cm⁻² of the cathode geometric surface area.

Additive-Free Fabrication of Spherical Hollow Palladium/Copper Alloyed Nanostructures for Fuel Cell Application

C. Hu, Y. Guo, J. Wang, L. Yang, Z. Yang, Z. Bai, J. Zhang, K. Wang and K. Jiang, *ACS Appl. Mater. Interfaces*, 2012, **4**, (9), 4461–4464

Spherical hollow Pd–Cu alloyed nanostructures supported on MWCNTs were obtained by alloying through a one-pot preparative method. A Pd(II) salt and a Cu(II) salt (atomic ratio 1:1) and MWCNTs were simultaneously dispersed into ethylene glycol in a stainless steel autoclave, and the pH was adjusted to 12. Then it was sealed and heated at 160°C for 6 h. The PdCu/MWCNTs exhibited a higher electrochemical active surface area than that of Pd/MWCNTs and therefore their electrocatalytic activity for formic acid oxidation was enhanced.

METALLURGY AND MATERIALS

Thermal Stability of Grain Structure and Material Properties in an Annealing-Twinned Ag–8Au–3Pd Alloy Wire

T.-H. Chuang, H.-C. Wang, C.-H. Tsai, C.-C. Chang, C.-H. Chuang, J.-D. Lee and H.-H. Tsai, *Scr. Mater.*, 2012, **67**, (6), 605–608

A large number of annealing twins can be observed in a Ag–8Au–3Pd wire. In contrast to the rapid grain growth in Au and Cu wires during ageing at 600°C, the grain size of this alloy wire remained almost unchanged. The annealing twins in this alloy wire exhibited increasing strength and elongation with ageing time. The electrical resistivity remained constant.

CHEMISTRY

High Energy Resolution Off-Resonant Spectroscopy at Sub-Second Time Resolution: Pt(acac)₂ Decomposition

J. Szlachetko, M. Nachtegaal, J. Sá, J.-C. Dousse, J. Hozowska, E. Kleyenov, M. Janousch, O. V. Safonova, C. König and J. A. van Bokhoven, *Chem. Commun.*, 2012, **48**, (88), 10898–10900

The decomposition of Pt(acac)₂ in H₂ induced by flash heating was investigated. The changes in the local Pt structure were followed using *in situ* high energy resolution off-resonant spectroscopy (HEROS). The metal complex was flash heated to 150°C and HEROS spectra were collected every 500 ms. The Pt(acac)₂ decomposition was shown to consist of a two-step reduction process of the Pt(II) species.

ELECTRICAL AND ELECTRONICS

Influence of Thin Platinum Layer on the Magnetic Properties of Multiple Layers of CVD Cobalt Thin Films

N. Deo, M. F. Bain, J. H. Montgomery and H. S. Gamble, *J. Mater. Sci.: Mater. Electron.*, 2012, **23**, (10), 1881–1886

Co layers were deposited by MOCVD on oxidised Si substrates at 450°C, in H₂ at ambient temperature with 2 Torr processing pressure. Pt layers were then deposited by E-beam evaporation in another vacuum system. Multiple layers of Co/Pt/Co and Co/Pt with Co thickness 15 nm and 30 nm and a 1.5 nm Pt spacer layer showed significant change in magnetic properties (coercivity H_c and magnetisation M_s). They had soft magnetic properties with H_c values of 51 Oe and 49 Oe, respectively, which are significantly less than the H_c values of single Co layers on oxidised Si.

NANOTECHNOLOGY

Controlled Synthesis of Concave Tetrahedral Palladium Nanocrystals by Reducing Pd(acac)₂ with Carbon Monoxide

H. Zhu, Q. Chi, Y. Zhao, C. Li, H. Tang, J. Li, T. Huang and H. Liu, *Mater. Res. Bull.*, 2012, **47**, (11), 3637–3643

Concave tetrahedral Pd nanocrystals with uniform sizes were prepared using Pd(acac)₂ as a precursor, PVP as a stabiliser and CO as a reducing agent under atmospheric pressure. The best CO flow rate, temperature and time for the formation of the ideal concave tetrahedral Pd nanocrystals were 0.033 mL s⁻¹, 100°C and 3 h, respectively. In the absence of CO, the reaction did not occur.

Microfluidic Size Selective Growth of Palladium Nano-Particles on Carbon Nano-Onions

F. Md Yasin, R. A. Boulos, B. Y. Hong, A. Cornejo, K. S. Iyer, L. Gao, H. T. Chua and C. L. Raston, *Chem. Commun.*, 2012, **48**, (81), 10102–10104

Size selective growth of Pd NPs (2–7 nm in diameter) on the surface of C nano-onions (CNOs) in water involved pretreating the CNOs with *p*-phosphonic acid calix[8]arene, **1**, then mixing with H₂PdCl₄ followed by dynamic thin film processing under H₂ in a vortex fluidic device (VFD). The control in particle size by varying the speed using the VFD was consistent with variations in mass transfer of H into the dynamic thin films.

